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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/626,212

07/24/2003

Christophe F. Pomarede

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06/02/2004

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER

LEE, HSIEN MING

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 06/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/626,212

Applicant(s)

POMAREDE ET AL.

Examiner

Hsien-Ming Lee

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 8, 11-15 and 17 is/are rejected.
- 7) ☐ Claim(s) 6, 7, 9, 10, 16, 18 and 19 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

Hsien Ming Lee 5/28/2004

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5 and 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huff et al. (US 5,950,107) in view of Ma et al. (US 6,200,866).

In re claims 1-2, Huff et al., in Figs. 4A-4G and related text, teach the claimed method of depositing a film (i.e. an oxide layer 450) over a surface (i.e. atop of metal stack 420a and 420b) in a partially fabricated integrated circuit, comprising:

- exposing the surface to products of a plasma (i.e. exposing the top surface and sidewalls of the metal stack 420a/420b of Fig. 4D to a nitrogen plasma 495 of Fig. 4E, col. 7, lines 5-6 and col.), thereby modifying termination of the surface (i.e. the plasma treatment creates open molecular bonds on the surface of the metal stack 420a/420b causing the interface between the metal stack 420a/420b and an interlayer dielectric 450 more adhesive, col. 6, lines 43-50, col. 7, lines 19-39) without significantly affecting bulk properties beneath the surface; and
- after modifying the surface termination, depositing the interlayer dielectric layer 450 thereover.

In re claims 11-13, Huff et al., also teach the claimed method of depositing a film in a partially fabricated integrated circuit, as stated above, comprising:

- exposing the surface, wherein the surface is defined by a semiconductor structure, to products of the nitrogen excited plasma, thereby modifying termination of the surface without depositing greater than one atomic monolayer of the products of the plasma on the surface; and
- after modifying the surface termination, depositing the interlayer dielectric layer thereover.

In re claims 1-5, 14-15, Huff et al. do not teach utilizing an atomic layer deposition (ALD) for depositing the dielectric layer 450 having a dielectric constant higher than that of silicon nitride such as zirconium oxide or hafnium oxide.

However, Ma et al. in an analogous art, teach utilizing the ALD process for depositing an oxide having dielectric constant higher than silicon nitride, such as zirconium oxide (ZrO_2) and hafnium oxide, as the dielectric (col. 6, lines 20-34).

Therefore, it would have been obvious to one of the ordinary skill in the art, at the time of the invention was made, to employ the ALD method as taught by Ma et al. to form the dielectric of Huff et al., since by doing so it would be able to form the high-dielectric-constant material as the dielectric layer having the advantages of high breakdown strength (col. 6, lines 20-24, Ma et al.) and better step coverage.

3. Claims 8 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huff et al. (US '107) in view of Ma et al. (US '866) as applied to claim 1 above, and further in view of Subrahmanyam et al. (US 6,107,192).

Huff et al. in view of Ma et al. substantially teach the claimed method, including exposing the surface to the nitrogen plasma to modify termination of the surface. Huff et al. in view of Ma et al. do not teach that the plasma is generated remote from the surface.

However, Subrahmanyam et al., in an analogous art of surface treatment, teach utilizing remote plasma to provide the radicals delivering into a treating chamber for treating a layer surface prior to depositing an overlying layer (see abstract and col. 3, lines 1-54).

Therefore, it would have been obvious to one of the ordinary skill in the art, at the time of the invention was made, to employ the remote plasma process as taught by Subrahmanyam et al. in treating the surface of metal stacks of Huff et al. in view of Ma et al., since by this manner it would satisfactory remove undesirable residual and/or contaminant from the surface prior to the subsequent depositing, which in turn would improve the adhesion between the layers. (col. 7, lines 24-46, Subrahmanyam et al.)

Allowable Subject Matter

4. Claims 6, 7, 9, 10, 16, 18 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

5. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record either alone or combination neither teaches nor suggests that the exposing incorporates *less than 10 atomic %* of the products of the plasma at a depth of *greater than about 10 Å* from the surface; that the surface is a gate dielectric surface; that the atomic deposition process comprises *two reactant pulses with intervening purge pulses in each cycle*.

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6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 571-272-1863. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Hsien-Ming Lee
Primary Examiner
Art Unit 2823

May 28, 2004

Hsien Ming Lee
5/28/2004